Modeling Mental Waves in Multidimensional Cognitive Spaces

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Abstract

This essay presents an original proposal to represent mental processes through computational simulations of cognitive waves in a multidimensional space. Using a synthetic model developed in Python, we analyze the interactions between mental functions such as attention, intention, and coherence, projected across symbolic, affective, structural, intuitive, and sensory dimensions. The goal is to visualize interference patterns that can be interpreted as cognitive activations.

1 Introduction

The human mind operates on multiple simultaneous levels, where each cognitive dimension contributes to the construction of conscious experience. This work proposes an analogy between mental functions and wave properties, allowing a dynamic representation of internal processes. The computational modeling of these waves offers a tool to explore the complexity of cognition from a visual and analytical perspective.

2 Theoretical Framework

The proposal is based on three conceptual pillars:

- Symbolic neurodynamics: oscillatory patterns that encode meanings and emotions.
- Cognitive dimensions: symbolic, affective, structural, intuitive, and sensory.
- Mental waves: attention, intention, and coherence as time-modulated functions.

3 Methodology

A Python model was developed to simulate sinusoidal waves with random parameters of frequency, phase, and amplitude. Each wave is projected over a temporal axis and grouped by dimension. When the sum of intensities exceeds a predefined threshold, a cognitive activation is recorded. This approach allows observation of the internal dynamics of the mind from a synthetic perspective, without relying on external empirical data.

4 Results

The model generated visualizations where interference patterns appear at specific moments. The intuitive and affective dimensions showed a higher frequency of activations, suggesting particular sensitivity to the overlap of mental functions. These activations are interpreted as moments of high cognitive load, potentially linked to states of concentration, internal conflict, or decision-making.

5 Dynamic Formalization of Consciousness

To enrich the mental wave model, we incorporate a mathematical formalization inspired by the author's work *Consciousness as a Subjective Reflection of Reality* (Mas i Manjon, 2025), which proposes a classical model of consciousness based on the interaction between attention and dimensional influence.

Let us consider the following system of equations:

$$\begin{cases} \dfrac{dA}{dt} = \alpha_1 - \alpha_2 AD + \alpha_3 AD^2, \\ \dfrac{dD}{dt} = \beta_1 - \beta_2 AD \end{cases} \tag{1}$$

Where:

- $A(t)$ represents the individual's attention over time.
- $D(t)$ represents the density of cognitive stimuli from the five dimensions.
- α_1 is the basal attention stimulus.
- $\alpha_2 AD$ is the cognitive interference due to overload.
- $\alpha_3 AD^2$ represents amplification through structural coherence.
- β_1 is the input flow of stimuli.
- $\beta_2 AD$ is the dissipation through conscious processing.

Equilibrium positions are obtained by solving:

$$A = \frac{\alpha_1\beta_2 + \alpha_3\beta_1}{\alpha_2\beta_2}, \quad D = \frac{\beta_1\alpha_2}{\alpha_1\beta_2 + \alpha_3\beta_1} \tag{2}$$

Emergent consciousness C is defined as:

$$C = \frac{\alpha_2}{\beta_2} = \frac{D(\alpha_1 + \alpha_3 AD)}{\beta_1} \tag{3}$$

Cognitive bifurcation occurs when:

$$\alpha_3 D^2 < \beta_2 A + \alpha_2 D \tag{4}$$

This system models how attention is modulated by the complexity and coherence of stimuli, and how consciousness emerges as a dynamic phenomenon.

6 Discussion

The wave-based representation of cognition offers an alternative approach to studying the mind. Although the model is synthetic, its ability to generate emergent patterns makes it a useful tool for theoretical and experimental exploration. Future versions may integrate real neurobiological data and be adapted for educational, therapeutic, or cognitive design environments.

7 Conclusion

Modeling mental waves in multidimensional spaces provides an innovative way to visualize and analyze the internal dynamics of the mind. This computational approach, complemented by a mathematical formalization inspired by classical models of consciousness, constitutes an original proposal with potential applications in neuroscience, education, and cognitive design.

Appendix: Excerpts from the Classical Model of Consciousness

The model presented in *Consciousness as a Subjective Reflection of Reality* proposes that consciousness is not a fixed entity, but an emergent function resulting from the interaction between attention, stimulus density, and structural coherence. Through a system of differential equations, it describes how attention amplifies or dissipates depending on the quality of stimuli, and how consciousness can bifurcate toward states of greater cognitive stability.

This approach allows mental states to be represented as dynamic attractors in a phase space, where the mind reorganizes itself based on internal coherence. The analogy with nonlinear physical systems opens the possibility of applying advanced mathematical tools to the study of the mind.

8 References

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